TWO NEW SPECIES OF *PROCLOEON* (EPHEMEROPTERA: BAETIDAE) FROM TEXAS[1]

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ABSTRACT: *Procloeon nelsoni*, new species, and *P. distinctum*, new species, are described from larvae and from male and female adults. Both species were collected from cool, alkaline waters of creeks and rivers in the hill country region of Texas. *Procloeon nelsoni* is most closely related to *P. diabolum*, also recently described from Texas, and probably represents a sister species. *Procloeon distinctum* is similar in both the larval and adult male stage to *P. rubropictum*, and probably represents a sister species.

Larvae of the small minnow mayfly genus *Procloeon* were recently characterized in the key to Nearctic genera by Edmunds and Waltz (1996) as having species with a truncate third segment of the labial palpi, incisors fused above the base or to the apex of at least one mandible, maxillary palpi segment three, if present, much shorter than segment two, all gills simple or with a single dorsal flap on all or some abdominal segments, and caudal filaments with lateral bristles to the apices. Adults were characterized as having single marginal intercalaries in the forewings, hindwings, if present, with a hooked costal process, a rounded or truncate penes cover between the basal segments of the male forceps, and lack of a spine shaped process between the basal segments of the male forceps.

While making collections in the spring of 1997, as part of my ongoing comprehensive study of the mayfly fauna of Texas, I discovered two previously undescribed species of *Procloeon* cohabiting the Blanco River in Hays County along with populations of *P. rufostrigatum* (McDunnough) and *P. viridoculare* (Berner). After subsequent collections it became evident that one species (*P. nelsoni* n. sp.) had previously been collected by C. R. Nelson and myself from the Devils River, Texas, where again it can be found to cooccur with *P. rufostrigatum*. The two new species are described here from larvae and male and female adults as *P. nelsoni*, new species, and *P. distinctum*, new species.

Collections and their abbreviations housing the material used in this study are as follows: The author's personal collection (NAW), Brackenridge Field Laboratory of the University of Texas at Austin (BFL), and the Purdue Entomological Research Collection (PERC).

Procloeon nelsoni, NEW SPECIES

(Figs. 1, 3-9)

Larva. Lengths: body 5.0-6.0 mm; caudal filaments 1.8-2.2 mm. Head: Coloration pale, without distinct patterning. Antennae pale, extending to or beyond midcoxae. Labrum (Fig. 3) sclerotized posterolaterally, slightly wider than long, with rounded anterior margin and

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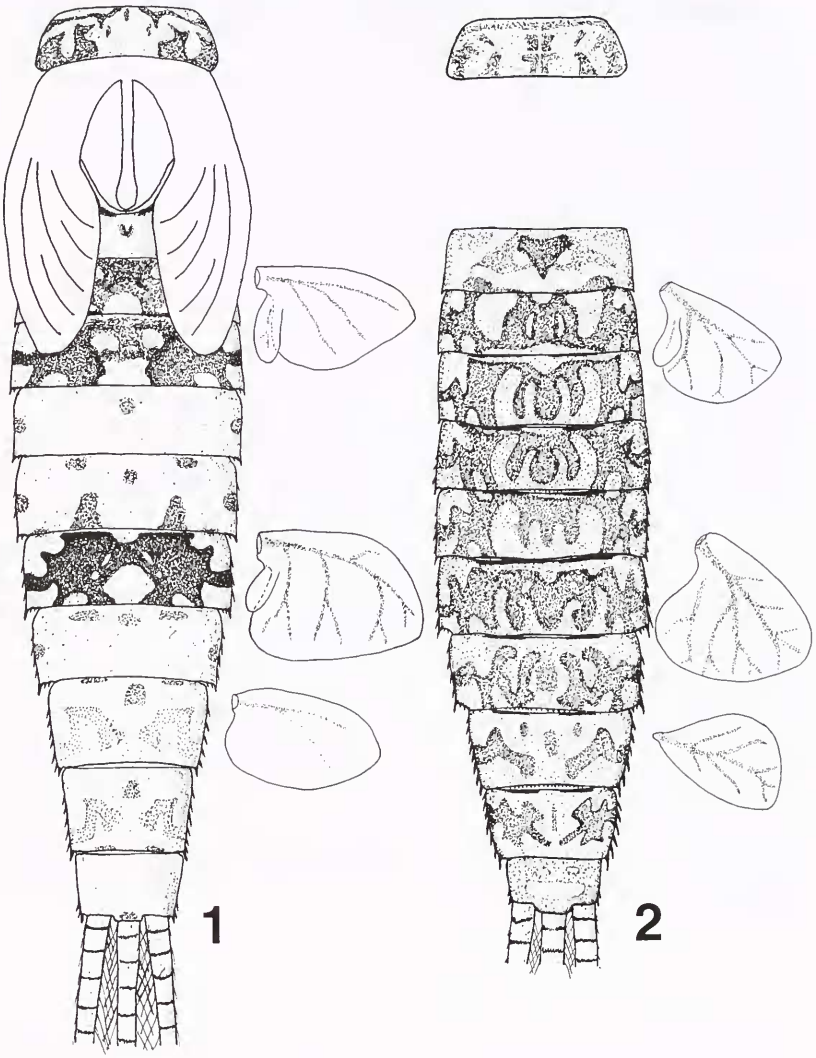


Figs. 1-2. 1. *Procloeon nelsoni*, n. sp., larval thorax, abdomen and gills 1, 5 and 7 (gills enlarged with respect to body, all figures dorsal). 2. *Procloeon distinctum*, n. sp., larval prothorax, abdomen and gills 1, 5 and 7 (gills enlarged with respect to body, all figures dorsal).

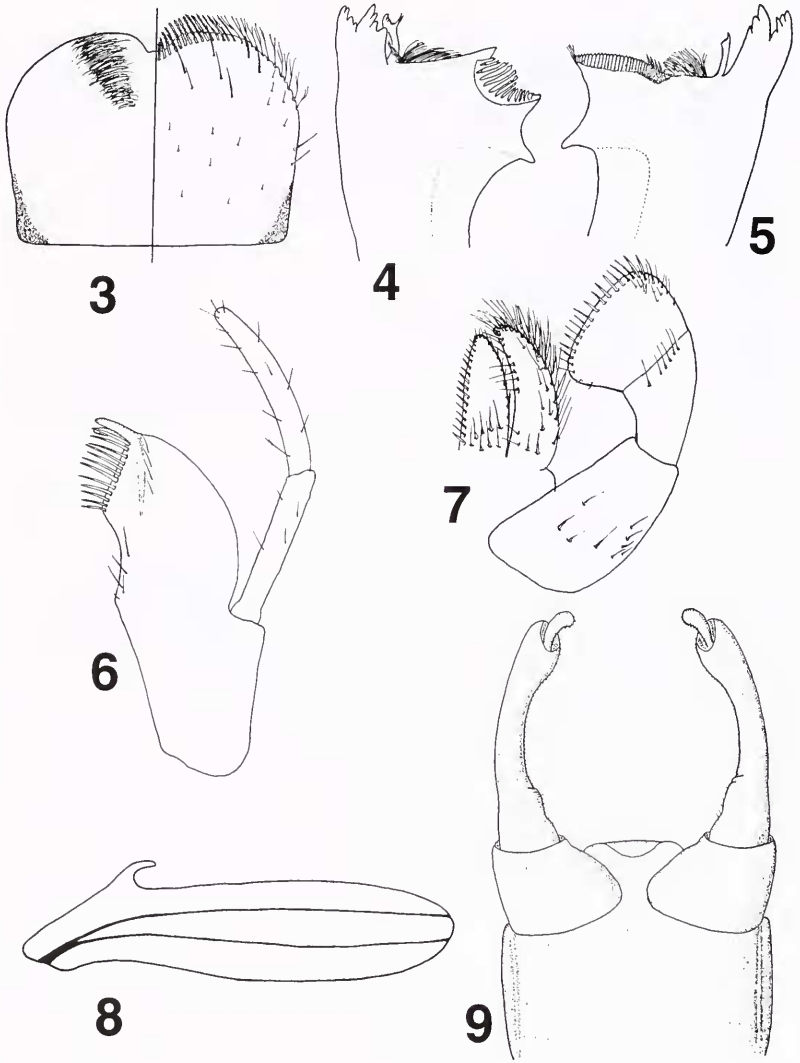
moderately deep medial emargination; anterior margin with bifurcate setae laterally and more robust, finely serrate setae medially. Left mandible (Fig. 4) with row of simple, fine setae between inner incisor and molar region. Right mandible (Fig. 5) with row of simple, fine setae between prostheca and molar region. Maxillae as in Fig. 6, with palpi two segmented and extending well beyond galealaciniae; palpal segment one about 3/4 to subequal to segment 2. Labium as in Fig. 7, with apically pointed glossae and paraglossae; palpi segment 3 truncate and medially expanded. Thorax: Prothorax as in Fig. 1, with distinct patterning of light and dark areas. Hindwingpads present. Legs: Femora with large, round, dark area distally, armored dorsally and ventrally with short, stout, simple setae and short, stout, finely, serrate setae; tarsi bare dorsally; tarsal claws without denticles and about 2/3 length of respective tarsi. Abdomen: Tergal patterning variable, but most similar to Fig. 1 [some individuals may have a wide, dorsomedial, black line running from the head to the posterior end of segment 10]; gills 1-5 with recurved dorsal lamella, those on 6 and 7 simple; gills with simple margins and only fine, simple setae. Posterior margins of terga 3-9 with regular arrangement of long and short spines, similar to Fig. 15. Lateral spines reduced in number and size posterior to segment 8; absent on segments 1-3 or 1-4. Paraprocts with 8-10 marginal spines. Caudal filaments with darkened intersegmental areas and dark band subdistally and often apically; lateral setae to apices.

Adult male. Lengths: body 4.6-5.2 mm; forewings 4.2-4.6 mm; hindwings 0.6-0.7 mm; cerci 8.0-10.0 mm. Head: Coloration light brown darkest around lateral ocelli. Turbinate eyes bright yellow; upper portion of eyes large and divergent anteriorly. Antennae pale. Thorax: Coloration light yellowish brown with darker areas bordering sutures; pro- and metathoracic nota with distinct red marks along medial and pleural sutures; sterna paler than nota. Forewings with membrane and venation hyaline; marginal intercalaries single and elongate, those posterior to R_3 longer than respective distal crossveins. Hindwings (Fig. 8) relatively narrow, ca. 4.5 times as long as wide, with nearly straight anterior and slightly convex posterior margins, two longitudinal veins and hooked costal process. Legs pale, darkest distally. Abdomen: Terga 1-6 translucent white with yellowish overcast dorsally in fresh material and paired, submedial, transverse red dashes posteriorly, difficult to discern on segment 1, 7-9; faint traces of median reddish line on some terga, usually appearing as red medial dot anteriorly; pleura with small, longitudinal, dark dashes either faint or absent on segments 1-9, when present, generally localized in anterior half of segment; terga 7 and 8 or tergum 8 only, with black dash at 45° angle laterally; terga 7-10 golden yellow in fresh material. Sterna entirely pale. Genitalia as in Fig. 9. Cerci entirely pale, whitish.

Female adult. Lengths: body 4.5-5.0 mm; forewings 4.5-5.0 mm; hindwings 0.7-0.8 mm; cerci 6.5-7.5 mm. Coloration similar to male. No prominent dorsal and lateral, black branching tracheation marks present. Pleura occasionally with faint logitudinal dashes on some segments.

Diagnosis. Larvae of *P. nelsoni* are most similar to those of *P. diabolum* Baumgardner and Kennedy (1998), recently described from Texas. However, the two species are at once distinguished by gill morphology (i.e. gills 1-5 with dorsal lamella in *P. nelsoni* and gills 1-3 only with dorsal lamella in *P. diabolum*). Larvae of *P. rivulare* (Traver) vary in having dorsal lamellae on gills 1-4 or 1-5, small when present on gill 5, but are otherwise easily distinguished from the above species by the lack of lateral spines anterior to segment 8, shorter antennae, shorter, more robust, tarsal claws, three segmented maxillary palpi, and different tergal patterning.

Adult males are also most similar to those described for *P. diabolum*. However, *P. nelsoni* males are distinguishable by the presence of paired, submedial



Figs. 3-9. *Procloeon nelsoni*, n. sp., 3-7 Larva. 3. Labrum (right: dorsal, left: ventral). 4. Left mandible. 5. Right mandible. 6. Right maxillae. 7. labium (half, dorsal view). 8-9 Male adult. 8. Hindwing. 9. Genitalia (ventral).

red dashes posteriorly on most abdominal terga, presence of distinct red markings on thoracic nota, turbinate eyes that are divergent anteriorly, and the presence of yellowish overcast on abdominal terga.

Baumgardner and Kennedy (1998) felt that their field associated adults described as *P. diabolum* were most similar to the species *Centroptilum album* McDunnough, *C. convexum* Ide, and *C. walshi* McDunnough which are all clearly members of *Centroptilum s. s.*, and in fact the two latter species (*C. convexum* and *C. walshi*), are probably conspecific with the widespread and variable species *C. album*.

Adult females of *P. nelsoni* are separated from other Nearctic *Procloeon* species with hindwings by the complete absence of branching, black tracheation lines laterally and dorsally on some abdominal segments and the presence of paired, submedial red dashes posteriorly on most abdominal terga.

Material examined. HOLOTYPE: Male adult with larval and subimaginal exuviae, USA: TEXAS: Hays Co., Blanco River at Post Road, near Kyle; 29°56'08N, 097°53'40W; 05 May 1997 N.A. Wiersema (PERC). ALLOTYPE: Female adult with larval and subimaginal exuviae, same data and deposition as holotype. PARATYPES: Ten male and ten female adults with larval and subimaginal exuviae, same data, but 5 males and 5 females at BFL.

Other material examined. I collected all specimens listed below and they reside in my personal collection unless otherwise indicated. Seven male and seven female adults with larval and subimaginal exuviae, same data as holotype. TEXAS: Hays Co., Blanco River at Post Road, near Kyle; 29°56'08N, 097°53'40W; 14, 16, 24 and 29 April 1997 (larvae); 05 May 1997 (larvae). Blanco Co., Miller Creek at Hwy 290/281 interchange; 30°12'24N, 098°22'24W; 16 July 1997 (larvae). Kimble Co., South Llano State Park, South Llano River at low water crossing on park road 73; 30°27'01N, 099°48'48W; 14 April 1998 (larvae). Val Verde Co., Devils River riffles upstream of Dolan Falls, 28 October 1996, N.A. Wiersema & C.R. Nelson, EPA 100 sample (larvae, BFL). Val Verde Co., Dolan Creek, 17 October 1993, C.R. Nelson & S.M. Stringer (larva, BFL).

Etymology. This species is named after Charles Riley Nelson (Austin, Texas) in recognition of all the assistance he has provided me.

Remarks. The larvae of *P. nelsoni* have only been collected from a few creeks and rivers in the hill country region of Texas, but because it is commonly found in the creeks and springs associated with the Devils River drainage in West Texas it is highly probable that it will eventually be found in northeastern state of Coahuila, Mexico as well. Larvae are most commonly found in association with thick submerged stands of Water Willow (*Justica americana*), as well as other aquatic macrophytes at the edge of riffles or in the slower reaches of runs. The Blanco River and other collection sites originate and flow over the Balconian Escarpment of central Texas and are characterized as having relatively clear, cool, and alkaline waters. An account of the specific physicochemical parameters of the type locality of both new species can be found in Davis (1987).

Procloeon distinctum, NEW SPECIES

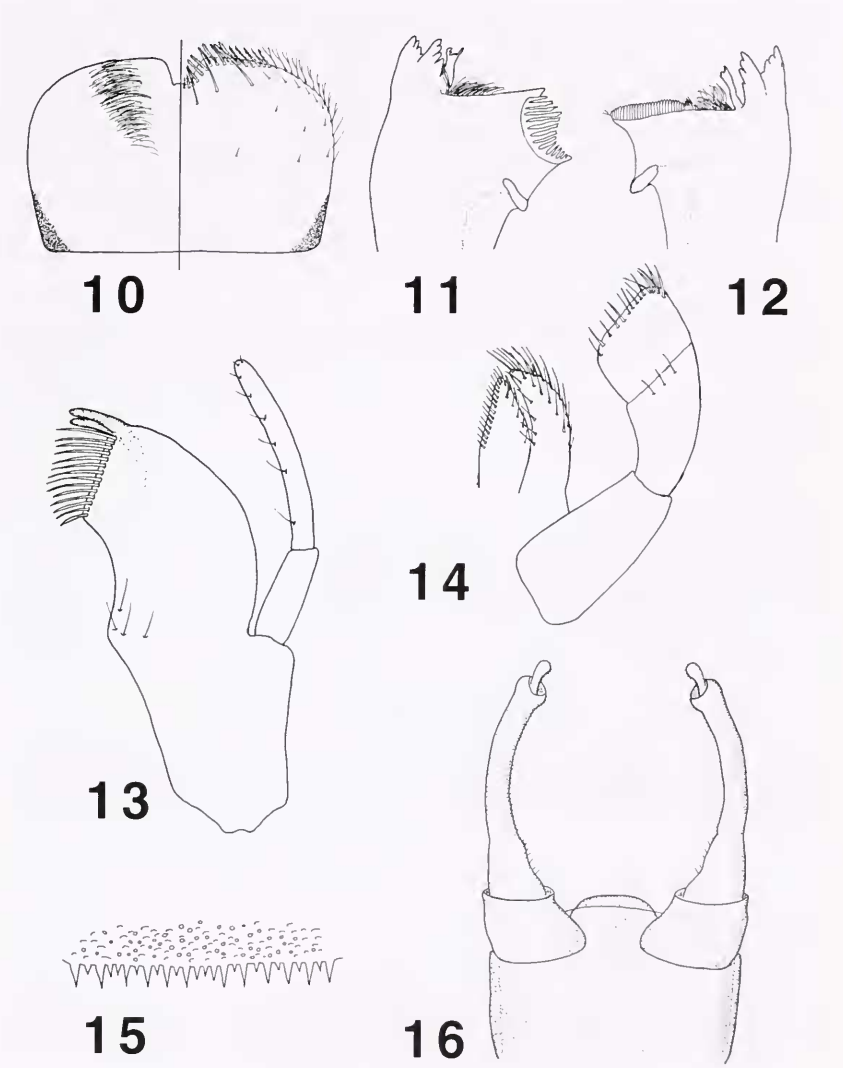
(Figs. 2, 10-16)

Larva. Lengths: body 4.8-5.5 mm; caudal filaments 2.0- 2.5 mm. Head: Coloration light to medium brown with fairly distinct, dark pattern bordering the coronal suture. Antennae extending to at least midcoxae. Labrum (Fig. 10) sclerotized posterolaterally, wider than long, with anterior margin nearly straight and deep medial emargination; anterior margin with bifurcate setae laterally and finely serrate setae medially. Left mandible (Figs. 11) with row of simple fine setae from base of inner incisor to molar region. Right mandible (Fig. 12) with row of simple fine setae between prostheca and molar region and tuft of more robust setae adjacent to molae. Maxillae as in Fig. 13, with palpi two segmented and extending to galealaciniae; palpal segment 1 about 1/2 as long as segment 2. Labium (Fig. 14) robust and elongate with glossae and paraglossae apically pointed; palpal segment three obliquely truncate. Thorax: Prothorax as in Fig. 2, with distinct patterning of light and dark areas. Hindwingpads absent. Legs pale to yellowish; femora with nearly straight margins and dark areas distally; tarsi heavily armored with many robust, finely serrate setae and few robust, simple setae ventrally; tarsal claws about 1/2 as long as respective tarsi with two rows of 6-8 large denticles, increasing in length distally. Abdomen: Terga usually with patterning similar to Fig. 2 [some mature specimens will show emerald green area medially near the posterior margin of segment 2, as in the adults (see below)]; gill 1 only with recurved dorsal lamella, gills on 2-7 simple; gills with simple margins and only scattered fine, simple setae; some gills may have reddish pigmentation basally. Posterior margins of terga 3-9 with regular arrangement of longer and short spines similar to Fig. 15, more basal terga with spines reduced in size. Sterna entirely pale or with broad, transverse brown lines on the anterior margin of segments 2-9. Lateral spines prominent on segments eight and nine, reduced in number and size on 3-7. Paraprocts with 11-13 marginal spines. Caudal filaments darker every fourth intersegmental areas and dark band subdistally, with lateral setae present to apices or occasionally absent distally.

Male adult. Lengths: body 4.0 mm; forewings 3.8 mm; cerci 7.8 mm. Head: Coloration reddish brown, darkest area around lateral ocelli. Turbinate portion of compound eyes kidney shaped, widely separated and divergent anteriorly; upper portion reddish-orange, lower portion reddish brown. Antennae pale, with flagellum darker than scape and pedicel. Thorax: Pronotum dark reddish brown; meso and metanota medium reddish brown with darker areas bordering sutures, sterna paler. Wings with membrane and venation hyaline; faint, brownish staining bordering attachment areas; marginal intercalaries single and elongate, those posterior to R_3 as long as respective distal crossveins. Hindwings absent. Legs pale, (missing or damaged on left side). Abdomen: Terga 1-6 translucent white with paired, submedial, red dashes posteriorly and small, very faint traces of a reddish median line on some terga; tergum 2 with a large emerald green area medially in the posterior half of the segment; terga 7-10 bright reddish brown with paired reddish posterior dashes obscured on segments 7-9; segment 1 with black pigmentation laterally and segments 2-7 with black, longitudinal dashes laterally; segment 8 with black dash at 45° angle; Sterna whitish. Genitalia as in Fig. 16, with penes cover broadly rounded. Cerci whitish.

Female adult. Lengths: body 3.8-4.2 mm; forewings 3.8-4.0 mm; cerci 7.0-7.5 mm. Body entirely bright greenish yellow. No distinct markings except an emerald green mark posteriorly on tergum 2.

Diagnosis. Larvae of *P. distinctum* are similar to *P. rubropictum*, but are separable by having a more robust labium (Fig. 14), with palpi segment 3 obliquely truncate, maxillary palpi with segment 1 about 1/2 as long as segment 2 (Fig. 13), tergal patterning similar to Fig. 2, leg setation, and shorter more robust,



Figs. 10-16. *Procloeon distinctum*, n. sp., 10-15 Larva. 10. Labrum (right: dorsal, left: ventral). 11. Left mandible. 12. Right mandible. 13. Right maxillae. 14. Labium (half, dorsal view). 15. Posterior margin of 4th abdominal tergite. 16. Male genitalia (ventral).

distinctly denticulate tarsal claws. *Procloeon rubropictum* larvae tend to have labial palpi segment 3 medially expanded more similar to *P. nelsoni* (Fig. 7), maxillary palpi with segment 1 subequal-equal to segment 2, tergal patterning not as above (although some individuals may exhibit a similar patterning on some segments), relatively sparse leg setation, and longer, thinner, poorly denticulate tarsal claws. Some individuals of *P. distinctum* may be further separated by the presence of broad, transverse, brown lines on the anterior margins of abdominal sternites 2-9, which are absent in *P. rubropictum*.

Adult males of *P. distinctum* are also similar to *P. rubropictum*, but are separable by the presence of an emerald green area medially near the posterior margin of abdominal segment 2 and a broadly rounded penes cover between the basal segments of the genital forceps as opposed to a more or less rectangular-shaped penes cover in *P. rubropictum*. Lowen and Flannagan (1992) stated that an emerald green spot may be present on abdominal segment 1 of live larvae of *P. rubropictum*, but gave no mention of it in the adults, nor have I ever observed it in any adults of *P. rubropictum*. Similar emerald green spots are often found in the closely related *P. rufostrigatum* as well, but are generally found on all abdominal terga. Based on the one adult male available *P. distinctum* also has far less extensive red markings on abdominal tergites 2-6 and particularly lacks the inverted "y-shaped" red mark often found on tergite 2 of *P. rubropictum* males.

Procloeon insignificans (McDunnough) also has similar genitalia to those of *P. distinctum* and *P. rubropictum*, but was described as lacking the paired, submedial red dashes found in the former species as well as black, longitudinal lines laterally. I have found these characteristics to be variable among some other species of the genus (unpublished). Further paired, submedial red dashes are very susceptible to fading in alcohol preserved specimens and are equally as hard to observe in pinned specimens. Based on the variation I have seen in *P. rubropictum* adult males, it appears *P. insignificans* may be conspecific with it, but until the larva of *P. insignificans* can be associated, its status will remain unclear.

Procloeon texanum McCafferty & Provonsha was essentially described from one male adult apparently reared from larvae collected from the Navasota River in Grimes County in southeastern Texas (McCafferty and Provonsha 1993). Based on the genitalia, size and lack of hindwings *P. texanum* is also similar to *P. distinctum*, but is separable by its light golden brown thoracic nota, pale abdominal terga 7-10, pale eyes, complete lack of any reddish or purplish markings dorsally or ventrally on abdominal segments 1-6 and male genitalia with a much more rounded almost subconical penes cover. Due to its proximity it is possible that *P. distinctum* and *P. texanum* will be found to be conspecific. However, repeated trips to the type locality of *P. texanum* have yielded no further specimens or possible larvae, thus any association is uncertain at this time.

Adult females of *P. distinctum* are clearly separated from females of *P. rubropictum* and all other known Nearctic *Procloeon* species that lack hindwings

by their bright greenish yellow coloration, emerald green spot on abdominal tergum 2 (as in the male), and the complete absence of any black tracheation lines laterally and dorsally. Females of the northern species *P. simplex* also tend to be bright greenish yellow in color and lack dark tracheation lines. However, *P. simplex* is restricted to the Northeast and upper Midwest in North America, lacks an emerald green spot on tergum 2, and is also considerably larger.

Material examined. HOLOTYPE: Male adult with larval and subimaginal exuviae, USA: TEXAS: Hays Co., Blanco River at Post Road, near Kyle; 29°56'08N, 097°53'40W; 05 May 1997 N.A. Wiersema (PERC).
PARATYPES: Four female adults with larval and subimaginal exuviae, same data and deposition as holotype.
Other material examined. TEXAS: Hays Co., Blanco River at Post Road, near Kyle; 29°56'08N, 097°53'40W; 14, 16, 20, 24 and 29 April 1997 N.A. Wiersema (larvae, NAW). Williamson Co., Georgetown, San Gabriel River at San Gabriel Park, blue pool above little dam, 28 April 1997 N.A. Wiersema (larvae, NAW).

Etymology. The specific epithet is a Latin word meaning separate or different. It is a reference to the unique and ornate nature of the tergal patterning of mature larvae.

Remarks. *Procloeon distinctum* is known from only two locations in the hill country region of central Texas and is possibly endemic to Texas. The larvae are most commonly found in association with submerged stands of Water Willow (*Justica americana*), as well as other aquatic macrophytes at the slower reaches of riffles and or runs.

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